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Lord Rosse in his *Observations of Nebulæ and Clusters of Stars* calls attention to wonderful loops and curved lines of stars.

By the photograph now presented and enlarged to the scale of 24 seconds of arc to one millimetre, the descriptions cited are confirmed, and some of the stars in the cluster appear to be double, triple, and multiple, and the region around is much crowded with stars, each one of which is now shown, to a scale, in true relative position and magnitude down to about the 16th. The configurations of the stars are, in the words of Lord Rosse, wonderful.

Photograph of the Cluster M. 50 Monocerotis.

By Isaac Roberts, D.Sc., F.R.S.

The photograph of the cluster M. 50 *Monocerotis*, R.A. $6^h\ 58^m$, Decl. 8°·11′ south was taken on the 10th March, 1893, with exposure of the plate during 90 minutes. It is No. 1483 in the *General Catalogue*, and is described by Sir J. Herschel as a remarkable cluster; very large; rich; pretty compressed; elongated; stars 12th to 16th mag.

Lord Rosse in his *Observations of Nebulæ and Clusters of Stars*, p. 55, 1852 to 1876, describes it as a coarse cluster; very large; straggling; irregularly round; spiral arrangement; extending about 15′ n. s. and 10′ p. f.; stars 12th to 15th mag.

The photograph shows the stars to be generally brighter and less numerous than those in the clusters M. 35 *Geminorum* and M. 36 and 37 *Aurigæ*, but it presents the same characteristics of apparent *comites* and double stars as those clusters. The photograph does not suggest the spiral arrangement referred to by Lord Rosse, and the stars are shown to about 16th mag.

Negatives of Jupiter, made with the Great Telescope of the Lick Observatory during the Opposition of 1892–3.

By Edward S. Holden, W. W. Campbell, and A. L. Colton.

We have the honour to present to the Royal Astronomical Society, in the name of the Lick Observatory, a series of negatives of *Jupiter*, made with the great telescope during the opposition of 1892–3, in continuation of similar work. The following memoranda should accompany them :—

The negatives were all made on specially fast plates, prepared for us by the Cramer Company, 8 × 10 inches in size. There are usually nine images of the planet on each plate. The enlargements were directly made in the telescope, using the full aperture of 33 inches, by means of a capital amplifying lens made for the Observatory at the cost of the Smithsonian Institution, by Mr. Brashear, from calculations by Professor

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C. S. Hastings, of Yale University. This lens is used so as to give a direct enlargement of about five diameters. The images under good circumstances are all that can be desired. It must be remembered, however, that the negatives are affected by the wind blowing on the telescope (and by other accidental disturbances), as if they were taken in the principal focus of a telescope 237 feet long.

Most of the exposures have been made by the three observers working together. All the plates have been developed by Mr. Colton. At first hydroquinone was used as a developer, but a pyro-developer was found to produce sharper contrasts. An exposure of two seconds is ample for the general features of the planet. Six seconds gives the satellites so that they are measurable. Each plate is marked (in Indian ink, which is presumed to be permanent) with sufficient data. The amplifying lens is set at 2·87 of its scale; the negative plate at 1·5 of the focusing scale. The times are Pacific standard times=G.M.T.−8 hours. Several negatives were made on each night, and the best have been selected for preservation at the Lick Observatory. All the others were called "duplicates," and as full a set of these as possible has been made up for presentation to the Royal Astronomical Society, irrespective of the excellence of the individual pictures, for reasons which are given in the *Monthly Notices*, vol. lii. p. 500. These negatives have been submitted to Mr. A. Stanley Williams, F.R.A.S., for examination and copying; and we take this opportunity of acknowledging his most welcome aid in the matter of the investigation and discussion of the plates.

List of Negatives of Jupiter presented to the Royal Astronomical Society.

Date.	Number of Images on the Plate.	Approximate P.S.T.	Remarks.
1892.		h m	
Oct. 20	9	8 16	No wind, but stars unsteady.
20	9	11 41	,, ,,
20	9	13 24	,, ,,
24	9	7 27	Shadow of I. on disc.
24	9	8 54	Shadows of I. and II. on disc.
24	9	10 15	
24	9	11 34	Through thick haze.
24	9	12 41	,, ,,
24	9	14 13	
Nov. 10	9	7 17	
10	9	9 3	
10	9	10 26	
10	9	11 42	
10	9	13 5	

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Date.	Number of Images on the Plate.	Approximate P.S.T.	Remarks.
1893.		h m	
Jan. 17	9	7 53	Stars unsteady. Shadow of I. on disc.
18	9	6 2	
18	9	7 58	Circumstances rather poor.
18	5	8 57	Planet low.

Mount Hamilton :
1893 *January* 19.

Note on the Lick Photographs of Jupiter, 1892–3.

By A. Stanley Williams.

The series of original negatives of *Jupiter* which has just been presented to the Society by the Lick Observatory is a remarkably fine one, and should form a valuable addition to the Society's collection of photographs. The following notes may be of interest as supplementing to some extent the paper by Messrs. Holden, Campbell, and Colton, read at the May meeting of the Society.

The method employed in taking these negatives has been considerably improved upon. There are now nine separate images of the planet upon each plate, and the times of the beginnings and endings of all the exposures are exactly recorded. It will, therefore, be possible to measure the positions of markings with great accuracy and satisfaction. From some experiments that I have been making in this direction, I think that measures made upon eight or nine images will be found to give the positions of spots with greater exactness than direct micrometer measures at the telescope.

The photographs themselves are, upon the whole, a great improvement upon those of previous years. The amount of small detail shown in some of them is simply immense, and the sharpness of the images really marvellous. The magnificent enlargement of 1892 Nov. 10, which accompanies the negatives, shows well some of the qualities and capabilities of the photographs. Here we have the equatorial diameter of *Jupiter*, measuring *nearly four inches*, and yet the chief belts and markings are distinct and fairly sharp in outline. Their positions could be measured pretty exactly with a measuring instrument of no greater degree of refinement than a foot rule.

This enlargement is an interesting one in several respects. Amongst other things it shows the two oldest, or longest-known features of the planet, the chief belts of course excepted. The first of these is the great red spot and the neighbouring region. The red spot, as usual, is plainer in the photograph than it was visually in the telescope. The other marking is of a different nature altogether. On the north side of the north

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equatorial belt opposite the red spot, but a little to the left of its centre, is a brighter spot, which makes a considerable indentation in the dark north equatorial belt. This spot was first recorded, by Mr. Denning, as long ago as 1885 Jan. 27. In the photograph it is plain enough even when viewed at the normal distance of vision, and it becomes quite glaringly conspicuous if the photograph be held at a distance of about four feet. Now this plainness is a curious thing, for I observed this spot frequently last year, and in the telescope it was *rather a faint spot*, so that relatively to other markings this bright spot was plainer photographically than visually last year; in this respect, therefore, it resembled the red spot, but probably from a different reason. The red spot comes out more distinctly because, on account of its reddish tint, it fails to affect the photographic plate. The bright spot, however, must, I think, have had a greenish or bluish tint, and its light has consequently caused a greater amount of photographic action than would otherwise have been the case. It may be mentioned that some of the other photographs show details in connection with this bright spot, which quite escaped my notice when observing the planet directly, although I paid a good deal of attention to the object last year. The same remark applies likewise to the red spot, and since the latter was so faint in the telescope last year, the fact that it is relatively plainer in the photographs is of great importance.

Many of the negatives in the present collection are good enough to stand enlarging considerably, though not, perhaps, to the extent of the magnificent specimen referred to above. I have been making some experiments in this direction lately, and present to the Society a positive enlarged about two diameters from the negative taken on 1892 October 24, at 12^{h} 42^{m} 28^{s}–32^{s} P.S.T. This enlargement shows much delicate detail in the form of spots, shadings, and other markings, and hence gives some idea of the beauty and capabilities of the original negative. On a mere casual glance I counted as many as thirty-seven or thirty-eight distinct spots, including under this name little projections on the edges of the belts. Most of these spots are plain and definite enough for their positions to be readily measured. An exhaustive examination would, of course, bring out many additional details.

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Immersions and Emersions of Jupiter's IV. Satellite. By Rev. S. J. Johnson, M.A.

At the Society's meeting, 1871 May 12, exactly twenty-two years ago, it was stated by Mr. Lassell that the calculations of the phenomena of *Jupiter's* satellites were "made to be used with a telescope of 46 inches focal length, but with the larger telescopes now in use the phenomena are seen at different times." The 46-inch telescope at the period referred to bore an aperture of 2¾ inches as a rule. As to the immersions and emersions of the IV. Sat. only, which are the least accurately known beforehand, the following are the differences from *Nautical Almanac* times which I have found with a telescope of this sort, viz., 3¼ inches, power employed 180.

It may readily be assumed that first or last visibility as seen with an instrument of this size would be pretty nearly equivalent to the intermediate time between first sight and full brightness in a large telescope, the mode usually adopted for observing these phenomena.

					By Naut. Alm.
			h m s		h m s
1877	Oct. 18	Em.	6 37 30	Haze	6 41 36
1879	Nov. 11	Em.	7 41 18		7 38 50
1884	Mar. 4	Im.	9 49 48		9 48 41
	Mar. 21	Em.	8 20 22		8 22 19
	May 10	Im.	10 2 51		10 2 25
1885	Apr. 27	Em.	8 39 45		8 35 43
1886	Mar. 11	Im.	10 34 57		10 45 2
		Em.	12 39 27		12 28 45
1890	Oct. 11	Im.	9 39 51		9 47 49
1891	Sept. 28	Em.	11 42 53	Haze	11 48 19
	Oct. 15	Em.	6 0 44		5 58 52
	Dec. 21	Em.	6 45 5		6 41 48

Difference from prediction varies from 26^{s} to 10^{m} 5^{s}.

Melplash Vicarage, Bridport:
May 6.